

CLAIMS

WHAT IS CLAIMED IS:

5 1. A magnet array for use in a planar motor having two opposing coil arrays; the magnet array having an upper surface and a lower surface and comprising a plurality of wedge magnets disposed in a plane, each wedge magnet having a magnetic polarity oriented at an angle relative to said plane, the magnets being arranged in groups, each group forming an upper resultant magnetic flux extending substantially perpendicular to said plane from
10 said upper surface of the magnet array and a lower resultant magnetic flux extending substantially perpendicular to said plane from said lower surface of the magnet array.

15 2. The magnet array of claim 1 wherein said wedge magnet group comprises two wedge magnets positioned along the upper surface of the magnet array and two wedge magnets positioned along the lower surface of the magnet array.

20 3. The magnet array of claim 1 wherein each wedge magnet has a magnetic polarity oriented at an angle perpendicular to said plane.

25 4. The magnet array of claim 1 wherein the upper resultant magnetic flux and the lower resultant magnetic flux of the wedge magnet group are oppositely directed.

 5. The magnet array of claim 1 wherein a sum of an attractive force of the upper resultant magnetic flux, an attractive force of the lower resultant magnetic flux, and a weight of a stage can be adjusted to zero at a nominal operating position of the stage.

 6. The magnet array of claim 1, further comprising:
 a magnetically permeable top plate to which the upper coil array is adjustably mounted such that a gap between the upper coil array and the top plate can be adjusted;

a magnetically permeable bottom plate to which the lower coil array is adjustably mounted such that a gap between the lower coil array and the bottom plate can be adjusted;

wherein the gaps can be adjusted to set to zero at the nominal operating position a sum of an attractive force of the upper resultant magnetic flux, an attractive force of the lower resultant magnetic flux, and a weight of a stage.

7. The magnet array of claim 1 wherein each wedge magnet group comprises four wedge magnets positioned along the upper surface of the magnet array and four wedge magnets positioned along the lower surface of the magnet array.

8. The magnet array of claim 1 further comprising a plurality of transverse magnets each having a polarity oriented parallel to said plane, at least one transverse magnet being disposed between adjacent wedge magnet groups.

9. The magnet array of claim 8 wherein each transverse magnet and adjacent wedge magnet groups form an upper continuous magnetic flux path and a lower continuous magnetic flux path.

10. An electric motor comprising:

an upper coil array;

a lower coil array; and

a magnet array movable relative to the upper and lower coil arrays and interposed therebetween, the magnet array having an upper surface and a lower surface and comprising a plurality of wedge magnets disposed in a plane, each wedge magnet having a magnetic polarity oriented at an angle relative to said plane, the magnets being arranged in groups, each group forming an upper resultant magnetic flux extending substantially perpendicular to said plane from said upper surface of the magnet array and a lower resultant magnetic flux extending substantially perpendicular to said plane from said lower surface of the magnet array;

the upper coil array being operable to interact with said upper resultant magnetic flux and the lower coil array being operable to interact with said lower resultant magnetic flux to move the magnet array relative to the coil arrays.

5 11. The electric motor of claim 10 wherein a sum of an attractive force of the upper resultant magnetic flux, an attractive force of the lower resultant magnetic flux, and a weight of a stage can be adjusted to zero at a nominal operating position of the stage.

10 12. The electric motor of claim 10, further comprising:
a magnetically permeable top plate to which the upper coil array is adjustably
mounted such that a gap between the upper coil array and the top plate can be adjusted;
a magnetically permeable bottom plate to which the lower coil array is adjustably
mounted such that a gap between the lower coil array and the bottom plate can be adjusted;
15 wherein the gaps can be adjusted to set to zero at the nominal operating position a
sum of an attractive force of the upper resultant magnetic flux, an attractive force of the
lower resultant magnetic flux, and a weight of a stage.

20 13. The electric motor of claim 10 wherein said wedge magnet group comprises two
wedge magnets positioned along the upper surface of the magnet array and two wedge
magnets positioned along the lower surface of the magnet array.

 14. The electric motor of claim 10 wherein the upper resultant magnetic flux and the
lower resultant magnetic flux of the wedge magnet group are oppositely directed.

25 15. The electric motor of claim 10 wherein each wedge magnet group comprises four
wedge magnets positioned along the upper surface of the magnet array and four wedge
magnets positioned along the lower surface of the magnet array.

16. The electric motor of claim 10 further comprising a plurality of transverse magnets each having a polarity oriented parallel to said plane, at least one transverse magnet being disposed between adjacent wedge magnet groups.

5 17. The electric motor of claim 16 wherein each transverse magnet and adjacent wedge magnet groups form an upper continuous magnetic flux path and a lower continuous magnetic flux path.

10 18. The electric motor of claim 10 wherein the upper and lower coil arrays comprise a plurality of coils each having a toroidal shape.

19. The electric motor of claim 10 wherein one of the upper and lower coil arrays has an opening formed therein.

15 20. An exposure apparatus comprising:
an irradiation system for irradiating an article with radiation to form a pattern on the article; and
a stage positioning device for positioning the article relative to the irradiation system, the stage positioning device comprising:
20 a stage movable relative to the irradiation system and adapted for supporting the article;

25 an upper coil array;
a lower coil array; and
a magnet array attached to the stage, the magnet array having an upper surface and a lower surface and comprising a plurality of wedge magnets disposed in a plane, each wedge magnet having a magnetic polarity oriented at an angle relative to said plane, the magnets being arranged in groups, each group forming an upper resultant magnetic flux extending substantially perpendicular to said plane from said upper surface of the magnet array and a

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lower resultant magnetic flux extending substantially perpendicular to said plane from said lower surface of the magnet array;

the magnet array and stage being interposed between the upper and lower coil arrays, the upper coil array being operable to interact with said upper resultant magnetic flux and the lower coil array being operable to interact with said lower resultant magnetic flux to move the stage relative to the upper and lower coil arrays.

21. The exposure apparatus of claim 20 wherein a sum of an attractive force of the upper resultant magnetic flux, an attractive force of the lower resultant magnetic flux, and a weight of the stage can be adjusted to zero at a nominal operating position of the stage.

22. The exposure apparatus of claim 21, further comprising:

a magnetically permeable top plate to which the upper coil array is adjustably mounted such that a gap between the upper coil array and the top plate can be adjusted;

a magnetically permeable bottom plate to which the lower coil array is adjustably mounted such that a gap between the lower coil array and the bottom plate can be adjusted;

wherein the gaps can be adjusted to set to zero at the nominal operating position a sum of an attractive force of the upper resultant magnetic flux, an attractive force of the lower resultant magnetic flux, and a weight of a stage.

23. The exposure apparatus of claim 20 wherein said wedge magnet group comprises two wedge magnets positioned along the upper surface of the magnet array and two wedge magnets positioned along the lower surface of the magnet array.

24. The exposure apparatus of claim 20 wherein the upper resultant magnetic flux and the lower resultant magnetic flux of the wedge magnet group are oppositely directed.

25. The exposure apparatus of claim 20 wherein each wedge magnet group comprises four wedge magnets positioned along the upper surface of the magnet array and four wedge magnets positioned along the lower surface of the magnet array.

5 26. The exposure apparatus of claim 20 further comprising a plurality of transverse magnets each having a polarity oriented parallel to said plane, at least one transverse magnet being disposed between adjacent wedge magnet groups.

10 27. The exposure apparatus of claim 20 wherein each transverse magnet and adjacent wedge magnet groups form an upper continuous magnetic flux path and a lower continuous magnetic flux path.

15 28. The exposure apparatus of claim 20 wherein the upper and lower coil arrays comprise a plurality of coils each having a toroidal shape.

 29. The electric motor of claim 20 wherein one of the upper and lower coil arrays has an opening formed therein.